Heat Sealing Apparatus

The invention relates to an apparatus for heat sealing a pack. The apparatus is particularly suitable for heat sealing a pack to provide a monitored dosage system for containing and presenting medication, particularly medication in the form of tablets, pills or capsules.

Monitored dosage systems are designed to contain and present medication safely and securely for dosage to patients on a regular basis. Such patients are often in care homes or hospitals and nurses or carers are required to provide the patient with regular medication in a reliable manner.

Monitored dosage systems essentially take the form of a container with, for example, twenty eight pockets marked with the day of the week and date or day, into which a pharmacist places the prescribed dose for that particular patient on that day. The container is then sealed and provided to the nurse or carer who may open the appropriate sealed pocket on the appropriate day.

Conventional monitored dosage systems consist of a plastics member provided with typically either seven or twenty eight formations for creating individual pockets each for receiving a particular day's medication. In order to make up the monitored dosage system, the pharmacist sorts the relevant medication into the relevant pockets and then places the plastics member on a framework in a holding fixture. The pockets are then closed by heat-sealing an aluminium foil, for example, to the plastics member. When it is time to dose the patient, the medication may be released from the pockets by manually pushing through the aluminium foil.

The above containers are tested to a standard set by the United States Pharmacopoeia for vapour transmission. According to this standard, a container is classed as Grade A if the moisture transmission is less than 0.5 g/m^2 per day and as

Grade B if the vapour transmission is less than 5 g/m^2 per day. No conventional monitored dosage systems perform better than Grade B.

Heat sealers comprising a hot plate are known for sealing the above monitored dosage systems.

According to the invention there is provided apparatus for heat sealing a pack comprising a first pack member including a plurality of formations, each providing an open-topped receptacle, and a second pack member for sealing to the first pack member to close and seal the receptacles, the apparatus including a base and a lid for sandwiching the first and second pack members therebetween and heating means adapted to heat only selected areas of contact between the first and second pack members to seal the first and second pack members together, thereby closing and sealing the receptacles.

Preferably when the first and second pack members are sandwiched together between the base and the lid of the apparatus, the respective pack members include areas of contact therebetween which encircle the receptacles.

Preferably the heating means is adapted to apply heat only to selected contact areas between the receptacles, to join the first and second pack members to one another in the selected areas. The selected areas may substantially encircle the receptacles.

Preferably the base of the apparatus is adapted to receive a first pack member comprising a sheet of material with formations provided therein. The sheet of material may include a substantially planar part, the formations depending therefrom, the first pack member thereby having a flat upper face including holes defining the tops of the receptacles. The base may include a support member for receiving the first pack member, the support member including a substantially planar part for supporting the substantially planar part of the first pack member and a

plurality of holes or pockets in the planar part for receiving the formations of the first pack member.

Preferably the lid of the apparatus includes a substantially planar contact face for contacting a substantially planar second pack member when the first and second pack members are sandwiched between the lid and the base of the apparatus.

Alternatively, the lid could be adapted to contact a second pack member comprising a sheet of material including a plurality of formations therein.

Preferably the lid of the apparatus is movably attached to the base such that it may be moved between an open and a closed position. Preferably in the open position, the lid is spaced from the base such that the first pack member may be placed onto the base. Preferably in the closed position the lid and the base may sandwich first and second pack members therebetween, the second pack member contacting the upper face of the first pack member, thus defining the contact area between the first and second pack members. Preferably the overall contact area comprises the whole of the shape of the flat upper face of the first pack member, the overall contact area thereby including holes representing the regions of the receptacles. However, the whole of this overall contact area need not be heated.

Preferably the lid is hinged to the base. Preferably the apparatus includes catch means for holding the lid and the base firmly together in the closed position to sandwich the first and second pack members firmly therebetween. When the lid and base are held together by the catch means, preferably an overall pressure of between 15psi and 40psi is applied to a pack sandwiched therebetween. The pressure is preferably between 20psi and 30psi.

Preferably the lid includes heating means for heating the selected contact areas between the first and second pack members. The heating means may include a heating element through which a current may flow. The heating element may

comprise etched foil or alternatively a metal wire. The etched foil or metal wire may be encased in silicone rubber. The heating element may be mains powered or battery powered.

The base may also include heating means for heating the selected contact areas of the first and second pack members. The heating means may include a heating element through which current may flow. The heating element may comprise etched foil or a metal wire, either of which may be encased in silicone rubber. Preferably the heating element substantially encircles the receptacles to apply heat to selected contact areas which substantially encircle the receptacles.

Preferably the heating means is adapted to heat the selected contact areas to a temperature of at least 100°C and preferably about 150°C. Preferably the heating means is adapted to provide substantially no heating of air in the receptacles.

The apparatus may include a switch for closing to cause current to flow through the heating elements. The switch may close automatically when the lid is brought into its closed position. The switch may automatically remain closed for a predetermined time period, once it is closed. This time period may be between 1 and 10 seconds and is preferably 4 to 5 seconds. Alternatively, the switch may remain closed until a pre-selected temperature is reached.

The apparatus may include a controller for controlling the flow of current, and a temperature sensor for providing a temperature signal to the controller. The temperature sensor may be positioned on or near to the heating element. The controller may include means for controlling the time for which current flows through the heating element and/or the level of current flow.

Preferably the apparatus is portable, having a weight of less than 5kg, and preferably less than 4kg.

According to the invention there is further provided apparatus for forming a sealed monitored dosage pack, the apparatus being according to any of the preceding definitions.

The apparatus may further include a pack comprising a first pack member including a plurality of formations, each providing an open-topped receptacle, and a second pack member for sealing to the first pack member to close and seal the receptacles.

Preferably the first and second pack members comprise plastics sheets.

The first pack member may comprise a planar part, the formations depending from the planar part. The second pack member may be generally planar.

Preferably the first and second pack members are formed as a unitary component. A plastics hinge may be provided between the first and second pack members so that the second pack member may be hinged between an open position and a closed position where it closes the receptacles.

Preferably the first and second pack members are formed from a laminate of polypropylene, which is preferably between 200 and 450 micrometers thick and most preferably about 300 micrometers thick, and polyethylene. Preferably the layer of polyethylene forms an adhesive when heated, and is between 30 and 50 micrometers thick, and most preferably about 40 micrometers thick.

The receptacles may be generally cuboid or oval in shape. Preferably each receptacle is between 15 mm and 40 mm in length, between 5 mm and 25 mm in width and between 5 mm and 25 mm in depth. Most preferably, each formation is about 25 mm in length, 15 mm in width and 10 mm in depth. Preferably the first pack member includes at least seven formations and may include twenty eight formations.

The plastics material of the first and second pack members could be pre-coated with a hot melt adhesive, the thickness of the coating being at least 15 micrometers, as an alternative to using a polyethylene layer as the adhesive.

The adhesive would preferably be a hot melt adhesive which could include a polyester resin. The hot melt adhesive may be a single component, solvent-borne formulation based on the polyester resin. The resin may a thermoplastic, high molecular weight, saturated polyester. The polyester resin may be a flexible amorphous polymer, which preferably has slight tackiness at room temperature, high elongation and moderate tensile strength.

According to the invention there is further provided a method of heat sealing a pack comprising a first pack member including a plurality of formations, each providing an open-topped receptacle, and a second pack member for sealing to the first pack member to close and seal the receptacles, the method including the steps of:

providing an apparatus including a base and a lid for sandwiching the first and second pack members therebetween and heating means provided in the base and/or the lid;

placing the first and second pack members in the apparatus and manipulating the base and/or the lid to sandwich the first and second pack members between the base and the lid; and

using the heating means to heat only selected areas of contact between the first and second pack members to seal the first and second pack members together, thereby closing and sealing the receptacles.

Preferably the heat is applied only to selected contact areas between the receptacles. The selected areas may substantially encircle the receptacles. Preferably heat is not applied directly to the receptacles.

Preferably the heat is applied for between 1 and 10 seconds and most preferably between 4 and 5 seconds. The method may include the step of controlling the application of heat in dependence upon a temperature feedback signal.

Preferably the method is for forming a sealed monitored dosage pack and includes the step of placing a substance in each of the receptacles before positioning the second pack member over the first pack member and manipulating the base and lid to sandwich the pack members therebetween. Preferably the substance is a medication.

An embodiment of the invention will be described for the purpose of illustration only with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatic plan view of a pack for forming a monitored dosage system, in an open position before sealing, viewed from the inside;

Fig. 2 is a diagrammatic side view of the pack of Fig. 1;

Fig. 3 is a diagrammatic plan view of the pack of Figs. 1 and 2, in its closed position;

Fig. 4 is a diagrammatic side view of the pack of Fig. 3;

Fig. 5 is a diagrammatic perspective view of a heat sealing apparatus according to the invention; and

Fig. 6 is a diagrammatic illustration of one possible layout of an element on the base or lid of the apparatus of Fig. 5.

Referring initially to Figs. 1 to 4, a monitored dosage pack 10 includes a first, lower pack member 12 and a second, upper pack member 14. The lower pack member 12 includes a sheet of plastics material provided with a plurality of formations, which create open-topped pockets 16, protruding down from a generally planar part 18. The pockets 16 may be generally cuboid or oval in shape and, when

the pack 10 is in its open position as illustrated in Figs. 1 and 2, their open tops allow medication to be placed therein, as described in more detail below.

Each pocket 16 is about 25 mm in length, 15 mm in width and 10 mm in depth and there are 28 pockets provided in the lower pack member 12.

The lower pack member 12 is made of plastics material which is about 300 micrometers thick.

The upper pack member 14 is also made of plastics material and is formed as a unitary component with the lower pack member 12, a plastics hinge 20 being provided therebetween. The upper pack member 14 comprises a sheet of material which again is about 300 micrometers thick.

The plastics material of the lower and upper pack members 12 and 14 comprises a laminate of polypropylene and polyethylene. The polyethylene acts as an adhesive, as described in more detail hereinafter.

The upper pack member 14 is provided with twenty eight widows 22 which, when the upper pack member is hinged into contact with the lower pack member 12, cover the open tops of the pockets 16. Each window 22 is defined by a weakened portion 24 in the plastics material of the upper pack member 14, each weakened portion defining a perimeter of its respective window 22. The weakened portion 24 is formed by partially cutting through the plastics sheet of the upper pack member 14. Attached to each window 22 is a release tab 26, manipulation of which allows the weakened portion 24 to be broken and the window 22 to be removed from the remainder of the upper pack member 14.

The monitored dosage pack is used as follows. With the pack in the open position illustrated in Figs. 1 and 2, a pharmacist de-blisters the relevant medication

for the patient in question and places the medication for each day of a four week period into the appropriate pocket 16.

The upper pack member 14 is then pivoted about the hinge 20 to bring its inner face 27 into contact with the top face 25 of the lower pack member 12. Temperature and pressure is then applied to melt the polyethylene and force the upper pack member 14 and the lower pack member 12 into contact with one another thereby adhering the two to each other; as described in more detail hereinafter. The contact area between the upper and lower pack members 12, 14 follows the shape of the upper face 25 of the lower pack member 12, including gaps aligned with the pockets 16.

Once the upper pack member 14 has been sealed to the lower pack member 12, each individual pocket 16 forms a sealed container (see Figs. 3 and 4). The monitored dosage apparatus may then be provided to the nurse or carer who is to dose the patient. On the appropriate day, the appropriate pocket may be opened by manipulating its release tab 26 and pulling, causing the weakened portion 24 to break and allowing the window 22 to be released from the remainder of the lid 14. This opens the individual pocket 16 allowing the medication to be released therefrom.

Referring to Figs. 5 and 6, there is illustrated a novel portable heat sealing apparatus 30 for heat sealing a pack such as the above monitored dosage pack. The apparatus 30 includes a base 32 and a lid 34 pivotally attached to one another by a hinge 36. The total weight of the apparatus illustrated in this example is about 2-2.5kg. In an alternative embodiment for heat sealing two packs simultaneously, the apparatus may weigh up to 4kg, but in either case is easily portable. The dimensions of the apparatus may be between about 0.2 and 0.5m by between 0.2 and 0.5m, again making the apparatus easily portable.

The base 32 of the apparatus 30 is generally rectangular in plan view, including straight sides 38 and ends 40, one of the ends 40 being hinged to the lid 34. The base has a depth of about 10 mm. The base 32 is provided with a support member 42 for receiving the first, lower pack member 12. The support member includes a planar part 44 for supporting the planar part 18 of the lower pack member 12 and a plurality of pockets 46 (only a few of which are shown) for receiving the formations in the lower pack member 12. In the illustrated example, the support member 42 includes twenty eight pockets 46, for receiving the twenty eight formations of the monitored dosage pack 10. The pockets 46 have a depth of around 8 mm.

The lid 34 is also generally rectangular in plan view, including straight sides 48 and ends 50, one of the ends 50 being hinged to the base 32. The lid 34 includes a substantially planar contact face 50 for contacting the upper pack member 14 as described in more detail below.

The lid 34 is provided with latch members 56 on its contact face 52, in an area remote from the hinge 36. The latch members 56 are adapted to engage complementary latch members 58 on the base 32.

The hinge 36 allows the lid 34 of the sealing apparatus 10 to be pivoted from an open position as illustrated in Fig. 5 where the lid and the base are generally spaced apart and a closed position in which the contact face 52 of the lid touches the planar part 44 of the base.

Both the planar part 44 of the base 32 and the contact face 50 of the lid 34 are provided with heating means as illustrated in Fig. 6. The heating means comprises an element 54 formed from etched foil encased in silicone rubber. The element 54 is preferably adhered to a layer of silicone foam rubber between 1.5 and 3mm thick, which is itself adhered to the planar part 44/contact face 50. The element is connected to a power supply which may be the mains or a battery. As

may be seen in Fig. 6, the element 54 traces a path over the surface of the planar part 44 or contact face 52 such that it substantially encloses or encircles the areas 55 which are aligned with the pockets, but does not extend into those areas.

The heat sealing apparatus 30 may be used as follows. With the lid 34 in its open position, a lower pack 12 member may be positioned on the support member 42 of the base 32 such that its formations extend into the pockets 46. An upper pack member 14 may be laid over the lower pack member 12 such that it covers the lower pack member so that the formations of the lower pack member now each define separate receptacles. The lid 34 of the apparatus 30 may then be pivoted relative to the base 32 such that the lid and the base sandwich the upper and lower pack members of the monitored dosage pack firmly together. The top face 25 of the lower pack member will be in contact with the inner face 27 of the upper pack member. The latch members 56 and 58 engage one another to hold the lid 34 and base 32 firmly together, thus applying pressure to the touching pack members to the monitored dosage pack. The silicone foam rubber helps ensure that any bumps, unevenness or undulations in the monitored dosage pack, the element or the material on which the element rests are evened out to ensure a successful heat seal.

The overall, average pressure applied to the pack is typically between 20 and 30psi. This is less than is required in the prior art. Because of the relatively small heated, sealing areas between the packs, the effect of this pressure is much greater than the average overall figures might suggest.

A controller (not illustrated) on the lid 34 of the apparatus may be operated to allow current to flow through the element 56, thus heating the contact face 52 of the lid 34 and the planar part 44 of the support member 42. This may happen automatically when the latch members 56 and 58 engage. This applies heat to the selected areas of contact between the top face 25 of the lower pack member and the inner face 27 of the upper pack member, these contact areas encircling and

surrounding the receptacles. The flow of current through the element 54 causes a very rapid heating which melts the polyethylene and seals the upper and lower pack members 12 and 14 together in these contact areas. This seals the receptacles. Current may typically be allowed to flow for 4 to 5 seconds whereupon it is automatically cut off. However, preferably the current is automatically cut off when or shortly after a predetermined temperature is reached. The apparatus may include a temperature sensor (not illustrated) for providing feedback to the controller. The controller may then control the duration and level of current flow to provide the optimal heating effect. Once the current has been cut off, the latch members 56 and 58 may disengage, or a small cooling period may be allowed before the latch members disengage.

The apparatus as described above solve various problems associated with prior art heat sealing apparatus. The inventor has appreciated that the prior art flat sealing plates can trap air between the lower and upper pack members and in the pockets and, whilst the flat sealing plate melts the plastics material or the adhesive it also heats and therefore expands the trapped air. This means that when the pressure of the hot plate is removed, the pressure of the heated air imperceptibly pulls the lower and upper pack members apart. When the pack members cool, this leaves unsealed areas which can allow moisture ingress.

The apparatus as described above avoids this result by only sealing in selected areas between the pockets/receptacles and preferably by heating the pack rapidly from both sides. The apparatus thus does not trap air between the upper and lower pack members and does not heat up the air in the pockets/receptacles so that after sealing and lifting the lid, there is no internal pressure to affect the seal integrity. In addition, the element heats up very rapidly and therefore need only be heated for the duration of the time needed to seal. This is in contrast to prior art arrangements where a large heavy sealing plate requires to be heated and, due to the length of time it takes to heat (typically 10 to 20 minutes), the apparatus tends to be left hot for long periods of time. Because the present apparatus only heats for

the duration of the time needed to seal, this reduces the electricity used and enables the user to allow for some cooling before opening up the apparatus. The release catch could be delayed such that it always allows for some cooling before releasing the pack. This would make the pack easier to remove by hand as would the fact that not all of the plastic is heated. An additional advantage of not heating all the plastic of the pack is that the material is less likely to distort leading to an incomplete seal. This also allows non heat-resistant ink to be used to print the pack, which can be of lower cost. The apparatus according to the invention is also portable, and takes up much less space than conventional heat sealers as it does not include the large and bulky sealing plate.

Various modifications may be made to the above described embodiment without departing from the scope of the invention. In particular the apparatus may be used to seal any suitable packs, not only monitored dosage systems, and may be modified to fit different sized/shaped monitored dosage apparatus, blister packs or other packs, and packs with different numbers of formations. The packs could be used to seal items other than medicines, for example foods. The shape and layout of the element may be varied, provided it seals adequately around the pockets 16.

Whilst endeavouring in the foregoing specification to draw attention to those features of the invention believed to be of particular importance it should be understood that the Applicant claims protection in respect of any patentable feature or combination of features hereinbefore referred to and/or shown in the drawings whether or not particular emphasis has been placed thereon.